REMARKS

Status of claims

Claims 1 to 30 are pending.

Claims 1, 18 and 30 are amended herein. Basis for the amendments is found in the original specification, *inter alia*, at paragraphs [0029] and [0037].

Fees

A petition for a 1 month extension of time with the requisite fee is filed with this response making this response timely in nature.

Applicant believes no additional fees are necessary at this time. However, in the event fees are required, Applicant authorizes the Commissioner to charge any necessary fees, including those under 37 CFR 1.16 and 1.17, to the nominated credit card in EFS-WEB.

35 USC 103(a)

Claims 1-7, 14, 16-26 and 30 stand rejected under 35 USC 103(a) as being unpatentable over Pierrejean (US Patent No. 6,388,384) in view of Pollard et al. With respect, the Applicant disagrees.

The independent claims 1, 18 and 30 have each been amended to define distinctions between ion sources of a type described in the present application and ion sources used for Time Of Flight Mass Spectroscopy such as described in Pollard.

In an ion source of the type described in the present application, an ionization region is established between an anode and an electron emitting cathode. An ionizable gas is provided into the ionization region. Electrons emitted by the cathode are accelerated toward the anode by an anode potential. As the electrons travel through the ionization region, they are accelerated until their energy becomes sufficient that collisions with the gas cause ionization of the gas. Positive ions produced in these collisions are accelerated out of the cathode end of the ionization region. The operation of the ion source described in the original specification at paragraph [0037]. Each of claims 1, 18 and 30 define these features by defining that the anode voltage creates a potential difference through the ionization region between the anode and the cathode. Claims 1, 18 and 30 also define that the electrons emitted by the cathode are accelerated through the ionization region and that the ions of the ion current are accelerated out of the second end of the ionization region, i.e. the cathode end of the ionization region. A person skilled in the art will readily understand that in order for charges to be accelerated in a region, a potential gradient must exist in that region.

By contrast, Pollard describes the use of electron impact ionization in a time-of-flight mass spectrometer. These spectrometers use electron impact to ionize a gas injected into an ionization region defined as an area between two grids, grids V_0 and V_1 (see Pollard, page 32, column 2, last 2 lines). This grid arrangement is shown in Fig. 1 of Pollard. In Pollard, the electron source is provided by a Filament which is shown in Fig. 1 as being outside of the ionization region and on the same side of the ionization region as grid V_1. As described at Pollard, page 33, column 2, line 22, electrons are only allowed into the ionization region when an appropriate voltage is applied to a Gate grid

disposed between the Filament and Grid V_1. Importantly, at page 33, from line 10, Pollard describes that the ionization region should be field free, i.e. **there is no potential difference across the ionization region**. That is, the electrons are accelerated to above an ionization energy before entering the ionization region.

Table 1 of Pollard indicates how the system would operate. When the Gate pulse is off, the Gate voltage is 972V which is below the filament voltage of 1002V and so no electrons flow to the gate. When the gate pulse is on, the Gate voltage is 1032V and so electrons are accelerated to the Gate. At the same time, the grid voltage V_1 decreases to 1072V and so the electrons that pass through the Gate will receive a further small acceleration as they travel to grid V_1. The grid V_0 is also at 1072V and so there is no acceleration of the electrons through the ionization region. When electrons enter the ionization region at their pre-accelerated energies, electron-impact ionization may occur. However, no ion current is emitted from the ionization region due to the lack of field. When the pulse goes off, the grid V_1 returns to its initial value of 1172V which makes the grid V_0 appear more negative, thereby accelerating the ions past grid V_0 and out of the top end of the mass spectrometer (i.e. in the opposite direction to the filament) towards the detector. Electrons are only attracted to the grid V_1 which serves as the anode.

As noted by the Office, Pierrejean teaches that in time-of-flight mass spectroscopy, the Filament may be substituted for a Field Emission cathode. The particular Field Emission cathode taught by Pierrejean is suited for the mass spectrometer of Pollard because it can produce a rapid rise pulse of electrons during the short pulse (600 nanoseconds) of the Gate voltage when electrons are emitted into the ionization region. However, other than the substitution of the Filament for a Field Emission

Cathode, no other modification of the mass spectrometer is taught, suggested or would be contemplated by a person skilled in the art.

When Pollard and Pierrejean are combined, either the Gate or the Grid V_1 of Pollard may be considered to be the anode 3 shown in Figure 1 of Pierrejean. Only the Gate or the Grid V_1 can provide an acceleration to the electrons, since the grid V_0 is shielded by grid V_1. The variable voltage V_{22} of Pierrejean would be synchronized to the Gate voltage so that the Field Emission cathode is emitting electrons at the time that the Gate voltage will allow the electrons to pass.

Claims 1, 18 and 30 each provide several patentable distinctions when compared to the combined teachings of Pollard and Pierrejean.

Claims 1, 18 and 30 each define that the ionization region is disposed between the anode and the cathode. As noted above, only the Gate or the grid V_1 of Pollard may be considered to be the anode and thus the anode and the cathode of Pollard are both taught as being on the same side of the ionization region.

Claims 1, 18 and 30 each define that that the electrons are accelerated through the ionization region. Pollard specifically teaches that the ionization region is field free and that no acceleration of the electrons occurs within the ionization region.

Claims 1, 18 and 30 each define that the ions of the ion current are accelerated out of the electron emitting cathode end of the ion source. Pollard specifically teaches that the ions are accelerated out of the ionization region in a direction opposite the electron emitting cathode end.

The Applicant therefore contends that claims 1, 18 and 30 are patentably distinguished over the combined teachings of Pollard and Pierrejean.

While a Field Emission cathode is a suitable substitution for a filament in a Time-Of-Flight Mass Spectrometry system, a Field Emission cathode is not suitable as an electron emitter in ion sources of the present type. As described at paragraph [0037] of the present specification, ions generated in an ion source of the present type are accelerated out of the open end of the ion source, i.e. past the cathode. The cathode is therefore exposed to some degree of ion bombardment. Ion bombardment can cause the micropoints of the Field Emission cathode to degrade heavily and rapidly, at which point the Field Emission cathode ceases to function. In addition, the materials used to make the Field Emission cathodes, including the substrate, insulative layer and grids may be incompatible with many applications of ion sources of the type presently contemplated. The Applicant therefore contends that a person skilled in the art would not substitute an electron emitting cathode with a Field Emission cathode in an ion source of the type contemplated in the present application. The Applicant considers that the definitions including in the independent claims that the anode and cathode are on opposite ends of an ionization region and that the ions of the ion current are accelerated out of the cathode end of the ionization region, provide a suitable distinction between ion sources of the type presently contemplated and mass spectrometry systems that also use some electron ionization principles.

Conclusion

The Applicant has presented amendments and submissions that the Applicant considers address all of the issues raised in the Office Action and places the application in

condition for allowance. Continued examination of the application is therefore respectfully requested.

Respectfully submitted,

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